WHAT IS CLAIMED IS:

1. A method for fabricating a semiconductor trench structure, the method comprising:

providing a semiconductor substrate;

forming a trench in the semiconductor substrate;

filling the trench with a filler material;

in a first thermal process having a first maximum temperature, curing the filler material, so that the filler material is thermally stable;

removing the filler material from an upper region of the trench as far as a boundary surface to define a collar region;

in a second thermal process having a second maximum temperature that is not significantly higher than the first maximum temperature, depositing a liner on the collar region and the boundary surface;

removing the liner from the boundary surface, thereby exposing the filler material; and

removing the filler material from a lower region of the trench.

2. The method according to claim 1, wherein

filling the trench with a filler material further comprises

selecting a material from the group consisting of a liquid filler and a filler material that is able to flow.

3. The method according to claim 1, further comprising selecting said semiconductor trench structure to be a trench capacitor.

4. The method according to claim 1, further comprising, in a third thermal process having a third maximum temperature,

providing a second liner on the trench wall prior to filling the trench,

removing the second liner from the lower region of the trench, and

using the first liner as a mask after removal of the filler material.

5. The method according to claim 1, further comprising
selecting the second thermal process to be a chemical vapor deposition process.

6. The method according to claim 1, further comprising
selecting the first maximum temperature to be at most 500°C.

7. The method according to claim 4, further comprising
selecting the third thermal process to be a conformal deposition process.

8. The method according to claim 1, further comprising
selecting the filler material to be an organic polymer that is thermally stable between 400°C and 500°C.

9. The method according to claim 1, further comprising
applying the filler material using a spin-on process.

10. The method according claim 1, further comprising
applying the filler material using a deposition process and
causing the filler material to flow.

11. The method according to claim 1, wherein the first thermal process further comprises
baking the structure to cause the filler material to flow, and
curing the filler material.

12. The method according to claim 1, further comprising
removing the filler material by an incineration process.

13. The method according to claim 12, further comprising selecting the incineration process to be an oxygen plasma process.

14. The method according to claim 1, further comprising applying a bonding agent to a surface of the trench prior to filling the trench.

15. The method according to claim 1, further comprising conditioning a surface of the trench prior to filling the trench.

16. The method according to claim 15, further comprising using a plasma process for conditioning the surface of the trench.

17. The method according to claim 1, further comprising selecting the liner to be an Al_2O_3 liner.

18. The method according to claim 17, further comprising, applying the Al_2O_3 liner at a temperature between 200°C and 300°C.